Comments of the Natural Resources Defense Council (NRDC) and the Union of Concerned Scientists (UCS) on the *2007 Integrated Energy Policy Report (IEPR)* Draft Staff Report "Comparative Costs of California Central Station Electricity Generation Technologies"

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1. Introduction and Summary

The Natural Resources Defense Council (NRDC) and the Union of Concerned Scientists (UCS) appreciate the opportunity to offer these comments on the California Energy Commission's (Commission or CEC) Draft Staff Report "Comparative Costs of California Central Station Electricity Generation Technologies" (draft report) for the *2007 Integrated Energy Policy Report (IEPR)*. This report was also discussed at a committee workshop held on June 12, 2007. NRDC is a nonprofit membership organization with a long-standing interest in minimizing the societal costs of the reliable energy services that Californians demand. We focus on representing our more than 124,000 California members' interest in receiving affordable energy services and reducing the environmental impact of California's energy consumption. UCS is a leading science-based nonprofit working for a healthy environment and a safer world. Its Clean Energy Program examines the benefits and costs of the country's energy use and promotes energy solutions that are sustainable both environmentally and economically.

NRDC and UCS commend the Energy Commission staff for developing the Cost of Generation (COG) model and draft report through a process that solicits input from stakeholders early and often. Our comments are summarized below:

- The COG model will be more valuable to policy makers if it presents the results of sensitivity analysis on the cost of greenhouse gas emissions and allows the user to vary the cost of greenhouse gas emissions in the model.

- The COG model should include the costs of carbon capture and storage (CCS) for coal-based power generation.
- The nuclear cost results presented in the COG Draft Report are too low.
- Assuming a forward-looking cost of generation for integrated gasification and combined cycle (IGCC) coal technology without assuming similar forward-looking costs for other generation technologies will confound comparison of costs across technologies.
- Merchant wind costs are unreasonably high.
- The draft report provides an incomplete picture of solar costs, and relies on assumptions that tend to unduly inflate costs.

2. The COG model will be more valuable to policy makers if it presents the results of sensitivity analysis on the cost of greenhouse gas emissions and allows the user to vary the cost of greenhouse gas emissions in the model.

Assembly Bill 32 (AB 32) creates a limit for California's greenhouse gas emissions. Pertinent work done by the Commission, including the final COG report, will likely be used in the AB 32 implementation process. To more fully inform statewide policy to reduce greenhouse gas emissions, we urge the Commission to include sensitivity analysis of the cost of emitting greenhouse gases in the final COG report. Giving policy makers a sense of how the cost of generation changes for different technologies depending on the assumed cost of emitting greenhouse gases will be critical as the state evaluates emission reduction options. At the minimum, we suggest a low ($8.50/metric ton CO2 equivalent), medium ($19.60/metric ton CO_2 equivalent) and high ($30.80/metric ton of CO_2 equivalent) cost of carbon be included in the final report. Given that assumed emission factors are already documented in the draft report, including a table that presents the cost of generation under the suggested carbon cost scenarios should be relatively simple.

Additionally, we suggest that the model itself allow users to define a cost of carbon for use in their own analysis. This will add further value to the COG model.

3. The COG model should include the costs of carbon capture and storage (CCS) for coal-based power generation.

Currently the costs of CCS are not presented in the COG Draft Report or in the COG model. We strongly urge the Commission to include CCS costs in the final report, as the use of this technology will be required to lower the emissions of coal generation to a level that will meet California's greenhouse gas emissions performance standard (EPS).

Currently, the emission rate assumed for integrated gasification combined cycle (IGCC) technology in the draft report is 1,928 pounds of CO_2 per MWh.[1] SB 1368 established a greenhouse gas performance standard "for all baseload generation of load-serving entities, at a rate of emissions of greenhouse gasses that is no higher than the rate of emissions of greenhouse gases for combined-cycle natural gas baseload generation." Recently, the Commission, along with the California Public Utilities Commission (CPUC), adopted rules and regulations that define this rate to be 1,100 pounds of CO_2 per MWh.[2] Given this rate, it will be impossible for long-term baseload power investments in IGCC plants to occur unless there is also investment in CCS to lower emissions below the EPS. Thus, it is pertinent that CCS costs also be included in the COG final report and model.

Several recent studies are available to inform generation of the cost premiums for CCS in IGCC plants. The Massachusetts Institute of Technology's study on the future of coal suggests that carbon capture alone (without storage) adds about $14/MWh to the levelized cost of an IGCC plant.[3] Additionally, a recent Standard and Poor's report suggests that CCS adds roughly $34-36/MWh to the costs of an IGCC plant ($450/kW to capital costs and $3/MWh to the operations and maintenance costs).[4]

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[1] Table 6, p. 17.
[2] CPUC D.07-01-039, January 25, 2007 and CEC Order No. 07-0523-7.
[3] Katzer, James, et al. *The Future of Coal: Options for a Carbon Constrained World.* 2007. http://web.mit.edu/coal/.
[4] Venkataraman, Swami. "Which Power Generation Technologies Will Take The Lead In Response To Carbon Controls?" S&P Viewpoint, May 11, 2007. http://www2.standardandpoors.com/portal/site/sp/en/us/page.article/3,1,1,0,1148444103469.html.

4. The nuclear plant levelized costs presented in the COG Draft Report are too low.

The COG draft report presents the levelized costs of nuclear power as $99.86/MWh, $73.75/MWh, and $67.01/MWh for merchant, investor owned utility, and municipal utility owned plants, respectively. We believe that these values do not reflect the cost of developing advanced nuclear plants today. In a recent report published by the Keystone Center, 27 nuclear power experts evaluated numerous levelized cost studies of nuclear power and also developed their own levelized cost model for nuclear power, finding "that a reasonable range for the expected levelized cost of nuclear power is between 8.3 and 11.1 cents per kWh [83 to 111 $ per MWh] delivered to the grid, before transmission and distribution costs."[5] The levelized costs of nuclear power currently listed in the COG draft report, specifically for IOU and municipally owned plants, are significantly lower than this range.

While we understand that the COG model allows for users to change input assumptions and to generate their own costs, the results presented in the COG report will undoubtedly be taken by many to be the cost of generation for particular resources. Presenting costs for nuclear power that are not consistent with current costs may misinform those who use the COG report alone as a data source. We suggest that the Commission re-evaluate the assumptions for nuclear power costs in the COG model. For instance, the COG draft report assumes that the installed cost of nuclear is $2,433/kW while the Keystone Center estimates that installed costs for nuclear power plants ranges between $3,600/kW and $4,000/kW.[6] The Keystone estimates may be conservative for California as they included plants developed in South Korea, which has considerably lower wage rates than the state, and excluded some high cost plants recently developed in Japan, in their sample. They may also underestimate the costs of decommissioning.

[5] The Keystone Center, *Nuclear Power Joint Fact-Finding*. June 2007. http://www.keystone.org/spp/documents/FinalReport_NJFF6_12_2007(1).pdf.
[6] Ibid. p 34.

5. Assuming a forward-looking cost of generation for integrated gasification combined cycle (IGCC) coal without assuming similar forward-looking costs for other generation technologies will confound comparison of costs across technologies.

During the course of the COG workshop on June 12, 2007, the Navigant consultant noted that that the IGCC input assumptions were based on forward-looking costs. Assuming lower forward-looking costs for IGCC while assuming current costs for other generation technologies will not allow for an "apples to apples" comparison of generation costs. We recommend that the use of forward or current cost assumptions be uniform across all technologies. This is especially important when evaluating the costs of technologies such as solar Stirling generation that is equally likely to come down in cost as the technology matures.

The assumed capital costs for IGCC may also be low. For example, the cost of the proposed Mesaba unit 1 in northern Minnesota, which recently went through an extensive review process and contested case proceeding before the Minnesota PUC, has capital costs of over $3,000/kW, and total costs of nearly $3,600/kW including financing, transmission, and other site costs. In addition, Black & Veatch (a large international construction and engineering firm) assumes overnight capital costs of $2,840/kW for a plant with an in-service date of 2010 and Standard and Poor's (S&P) assumes capital costs of $2,795/kW for using eastern coal and $2,925/kW for using western coal from the Powder River Basin.[7]

6. Merchant wind costs are unreasonably high.

The draft report relies on inaccurate assumptions that inflate the costs of merchant wind facilities. The draft report estimates that merchant wind plants cost approximately $99/MWh on a levelized basis, which is over $32/MWh more than the estimated cost for IOU-owned wind plants. This is inconsistent with RPS contracting activity in the state. To date, the three large IOUs have executed PPAs with at least 13 new merchant-owned

[7] Supra at note 4.

wind farms in the state.[8] None of these contract prices has exceeded the applicable Market Price Referent (MPR). The 2006 MPR, which was the highest since the beginning of the RPS program, was calculated to be $84.24/MWh ($2007).[9] Though wind generation prices have increased significantly in recent years, owing largely to turbine price increases, the ample contracting experience in the state provides no evidence to support the very high merchant wind costs that the draft COG draft report estimates. As a result, the estimated cost of merchant wind in the final COG draft report should be no higher than the 2006 MPR of $84.24/MWh.

The large difference in estimated cost for merchant and IOU owned facilities appears to result from the inaccurate financial assumptions that are shown in Table 8 of the draft report. The assumed cost of equity for merchant facilities of 15.19% is far too high for wind. This equity rate assumption might have been appropriate a few years ago, when the wind industry was much smaller and the financial community had much less experience with financing wind projects. In today's market, however, the cost of capital for merchant wind projects is similar to the cost of capital for IOU owned facilities. In fact, a recent U.S. Department of Energy report suggests that the cost of tax equity for high-quality financing agreements has declined by approximately 300 basis points in the past four years, and that interest rate margins have declined by approximately 50 basis points over the same period.[10] The final COG report should modify its financial assumptions for merchant wind facilities to reflect the current market.

7. The draft report provides an incomplete picture of solar costs, and relies on assumptions that tend to unduly inflate costs.

The draft COG report also paints an extremely incomplete picture of solar costs. The high cost estimates in the draft report appear to arise in part from the assumption that the 30% Investment Tax Credit (ITC) will not be extended at its current level beyond 2008. Congress is currently considering legislation that will extend the 30% tax credit

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[8] California Energy Commission, *Database of IOU Contracts for Renewable Generation*, updated 4/6/2007. Available at http://energy.ca.gov/portfolio/contracts_database.html.

[9] $84.24/MWh is the 2006 baseload MPR established by the California Public Utilities Commission for a 20-year contract that commences delivery in 2007. *CPUC Resolution E-4049*, dated December 14, 2006.

[10] U.S. Department of Energy, *Annual Report on U.S. Wind Power Installation, Cost, and Performance Trends: 2006*. May 2007.

for an additional eight years. To be conservative, the final COG report could assume a five-year ITC extension, which should significantly reduce the solar costs in the draft report. Furthermore, the draft COG report does not explain the dramatic differences between the costs of merchant and IOU owned solar facilities. For example, the draft report estimates that a 1-MW solar PV project will cost $608.42/MWh if merchant owned, compared to $396.30/MWh if the project is IOU owned. This result is even more puzzling upon considering the fact that the ITC is not available to IOU owned facilities. The final COG report should explain these cost disparities, and correct the assumptions that produced these unreasonable results, including financial assumptions and the COG model's treatment of tax credits. We recommend that the report authors consult with California and Nevada IOUs that have experience purchasing and contracting for power from utility-scale solar plants to benchmark the reasonableness of their cost estimates for different solar technologies.

Most of the solar technologies covered in the report are emerging technologies with little or no market share. Many of these technologies will be initially expensive to develop, but they have attracted the attention (and funds) of investors and California utilities because of their vast promise for future cost reductions with scale. By only providing a single estimate that essentially reflects the cost of the first generation of these technologies, the draft COG report may provide the misleading impression that the technologies are too costly and should never be pursued. Considering the acute cost sensitivity of advanced solar technologies to increased learning and scale, the final report should provide a range of costs or multiple costs for each technology to reflect the significant cost reductions that are expected as more facilities are developed.

8. Conclusion

In conclusion, NRDC and UCS thank the Commission for the opportunity to comment on the issues discussed at the COG workshop and we look forward to continued involvement in the COG process.